BULLETIN

OF THE INSTITUTE OF METALS

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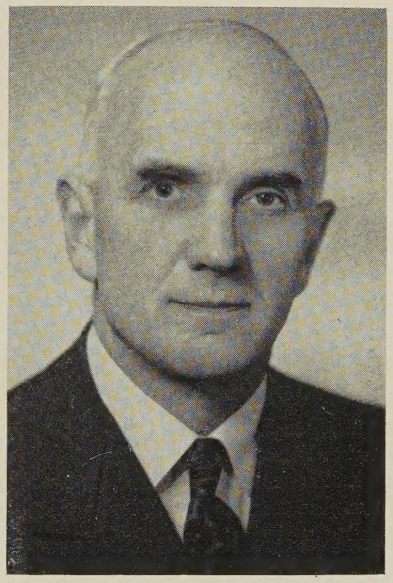
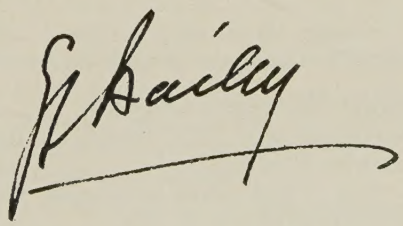
NEW YEAR MESSAGE FROM THE PRESIDENT



I am glad of this opportunity to convey to the members of the Institute a personal message of good wishes for a happy and prosperous New Year.

I deeply appreciate the honour conferred upon me by inviting me to this office, in holding which I have derived a great deal of pleasure from the friendly and helpful contacts with members in all parts of the country. It is on visiting the Local Sections that one becomes aware of the great loyalty and goodwill which members feel towards their Institute: on this foundation alone can the Institute hope to build its future and adapt itself to the changing needs of the times. The Council confidently looks to the continued interest and help of the members in making the work of the Institute even more successful in the coming year.



INSTITUTE NEWS

Prime Minister to be Principal Guest at Institute's Dinner

The Prime Minister (The Right Hon. HAROLD MACMILLAN, M.P.) has accepted an invitation to be the Institute's principal guest at the Annual Dinner to be held in London on Thursday, 31 March 1960, and to propose the toast of "The Institute of Metals and the Non-ferrous Metal Industries", to which Sir RONALD PRAIN, O.B.E., Hon.M.I.M.M., the newly-installed President, will reply. The American Ambassador (His Excellency JOHN HAY WHITNEY) will reply to the toast of "The Guests".

The Council is confident that members, appreciating the honour of entertaining these very distinguished guests, will support the dinner in large numbers.

The dinner will be held in the Great Room at Grosvenor House, which can comfortably accommodate 1000 diners. Tables for parties of 10 and 8 may now be booked; a limited number of tables for 12 will also be available.

Full details of the programme of the Spring Meeting, to be held from Tuesday to Thursday, 29–31 March, will be published shortly.

Council: Election to Fill Vacancies in 1960–61

In accordance with the Institute's Articles of Association, a certain number of members of the Council retire at the Annual General Meeting each year. In addition to such retirements in 1960, there is a vacancy caused by the resignation from the Council of The Hon. Geoffrey CUNLIFFE, which the Council has accepted with regret.

The following members are declared to be deemed to be elected to fill the vacancies on the Council, and will take office as from the Annual General Meeting on 29 March 1960:

President:

Sir Ronald PRAIN, O.B.E., Hon. M.I.M.M., Chairman and President, Rhodesian Selection Trust, Ltd.; Chairman and President, Roan Antelope Copper Mines, Ltd.; Chairman and President, Mufulira Copper Mines, Ltd.; Chairman and President, Chibuluma Mines, Ltd.; Chairman, Ndola Copper Refineries, Ltd.; Chairman, Anglo Metal Co., Ltd.; Director, International Nickel Company of Canada, Ltd.; Director, Metal Market and Exchange Co., Ltd.

Vice-Presidents:

H. M. FINNISTON, B.Sc., Ph.D., A.R.T.C., F.I.M., Research Manager, Nuclear Research Centre, C. A. Parsons and Co., Ltd.

H. W. G. HIGNETT, B.Sc. (Eng.), F.R.I.C., F.I.M., Assistant Managing Director, Henry Wiggin and Co., Ltd.

Ordinary Members of Council:

R.W. K. HONEYCOMBE, M.Sc., Ph.D., Professor of Physical Metallurgy, University of Sheffield.

Ivor JENKINS, D.Sc., F.I.M., Chief Metallurgist, Research Laboratories, The General Electric Co., Ltd.

E. ROBSON, Managing Director, The Manganese Bronze and Brass Co., Ltd.; Director, Lightalloys, Ltd.; and Chairman, The British Metal Sinterings Association.

J. SALTER, B.Sc.(Tech.), A.M.I.E.E., Director, The British Aluminium Co., Ltd.

Christopher SMITH, F.I.M., Works Director, James Booth and Co., Ltd.

Major C. J. P. BALL, D.S.O., M.C., F.R.Ae.S., will retire from the Council as a Past-President, and the vacancy will be filled by the retiring President, Mr. G. L. BAILEY, C.B.E., M.Sc., F.I.M.

The other members who will retire in 1960, in accordance with the Articles, are The Hon. John GRIMSTON (Vice-President), and Mr. G. E. DONO, J.P., and Mr. C. H. M. HOLDEN, F.I.M. (Ordinary Members of Council).

Election of New Members

The following 17 Ordinary Members, 8 Junior Members, and 29 Student Members were elected on 25 November 1959:

As Ordinary Members

BAYNES, Alan David, Assoc.Met., L.I.M., Metallurgist, The Park Gate Iron and Steel Co., Ltd., Rotherham.

BEISSEL, Frank Eric, A.I.M., Metallurgist, Turner Industries, Ltd., Nunawading, Vic., Australia.

BERNARD, Jean Louis, Ing., Head, "Structural Metals" Section, Commissariat à l'Energie Atomique, Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette (S. et O.), France.

BROWN, Terence Michael, B.Sc., Metallurgist, Northern Aluminium Co., Ltd., Banbury.

CLARK, Andrew John, B.A., Development Metallurgist, Northern Aluminium Co., Ltd., Banbury.

COLLIER, Fred Owen, Manager of Foundries, J. F. Collier and Co., Ltd., Macclesfield.

FINKL, Charles William, B.S., Vice-President, A. Finkl and Sons Co., Chicago, Ill., U.S.A.

HIRASE, Masakazu, B.Eng., Managing Director, Fuji Iron and Steel Co., Ltd., Chuo-ku, Tokyo, Japan.

LANGSTON, Merritt Eugene, M.S., Project Leader, Battelle Memorial Institute, Columbus, Ohio, U.S.A.

LUCASSON, Pierre, Doct. ès Sc., Ing. chim., Chargé de Recherches au Centre Nationale de la Recherche Scientifique, Laboratoire de Chimie Physique, Paris, France.

MADDOCK, Alan Julian, D.Sc., M.I.E.E., F.Inst.P., Deputy Director, British Scientific Instrument Research Association, Chislehurst, Kent.

O'LEARY, Maurice Grattan, B.A.Sc., Assistant to the General Works Manager, Northern Aluminium Co., Ltd., London.

ROBERTS, John Albert, B.Sc., Ph.D., Research Investigator, Fulmer Research Institute, Stoke Poges, Bucks.

SEAGER, Charles William, A.I.M., Experimental Officer, Metallurgical Department, Royal Ordnance Factories, Ministry of Aviation, London.

SERRAVALLE, Giovanni, Dott. Ing., Assistente di Metallurgia e Metallografia, Politecnico di Milano, Italy.

STEIN, George Ernest, M.S., Research Supervisor, Reynolds Metals Co., Metallurgical Research Laboratories, Richmond, Va., U.S.A.

TOBIAS, *Professor* Stephen Albert, D.Sc., Ph.D., M.A., A.M.I.Mech.E., Head of the Department of Mechanical Engineering, University of Birmingham.

As Junior Members

AVERY, Denis Frederick, L.I.M., Assistant Research Metallurgist, Telegraph Construction and Maintenance Co., Ltd., Metals Division, Crawley.

BIRD, Thomas Lewis, B.A., Research Officer, British Welding Research Association, Abington.

BONAR, Lucian George, B.A.Sc., M.S., Research Student, Department of Metallurgy, University of Cambridge.

BONNER, Peter Edward, L.I.M., Laboratory Assistant, British Non-Ferrous Metals Research Association, London.

COTTINGHAM, David Michael, B.Sc., Research Metallurgist, Research Laboratories, The General Electric Co., Ltd., Wembley.

JONES, Robert Barry, M.Met., 4th Assistant Engineer, Research and Development, Central Electricity Generating Board, c/o Department of Metallurgy, University of Sheffield.

RUSHTON, John Frederick, Foundry Technical Officer, The Harlow Metal Co., Ltd., Harlow.

SUTTON, Leslie John, L.I.M., Junior Metallurgist, Atomic Power Constructions, Ltd., London.

As Student Members

ANDREWS, Roy Charles, L.I.M., Assistant, Aluminium Laboratories, Ltd., Banbury.

BAKER, Clive, B.Sc., Research Student, Department of Metallurgy, University of Cambridge.

BUSHNELL, Gordon, Undergraduate, Department of Metallurgy, University of Cambridge.

BUTTERWORTH, David, Undergraduate, Department of Metallurgy, University of Sheffield.

CLARKE, John Frank Jerome, M.A.Sc., Research Student, Department of Industrial Metallurgy, University of Birmingham.

CUTLER, David Arthur James, Student of Metallurgy, Brunel College of Technology; Development and Research Department, The Mond Nickel Co., Ltd., London.

FLETCHER, Alfred John, B.Sc., Postgraduate Student, Department of Metallurgy, Royal School of Mines, University of London.

GARFORTH, Daniel, Undergraduate, Department of Metallurgy, University of Cambridge.

GILBERT, John Roger Bawden, Undergraduate, Department of Metallurgy, University of Cambridge.

GREATWOOD, Peter, Undergraduate, Department of Metallurgy, University of Cambridge.

HITCHCOCK, Robert Edward, Undergraduate, Department of Metallurgy, University of Cambridge.

JAMES, David William, Undergraduate, Department of Metallurgy, University of Manchester.

JENKINS, George Alan, B.Sc., Research Student, Department of Industrial Metallurgy, University of Birmingham.

LAWLEY, Derek Reginald, Experimental Assistant, The British Coal Utilization Research Association, Boiler Availability Project, College of Technology, Wolverhampton.

LETT, Graham Vincent, Undergraduate, Department of Physical Metallurgy, University of Birmingham.

MARSH, Anthony Edward, Undergraduate, Department of Metallurgy, University of Sheffield.

MORRIS, Anthony David, Undergraduate, Department of Metallurgy, University College of Swansea.

REA, Michael John, Student of Metallurgy, Battersea College of Advanced Technology, London.

ROBERTS, Errol Francis Ian, Undergraduate, Department of Metallurgy, University College of Swansea.

ROLLINS, Victor, Student of Metallurgy, Battersea College of Advanced Technology, London.

SHEASBY, John Seymour, Undergraduate, Department of Physical Metallurgy, University of Birmingham.

STEVENS, Ralph Norman, Undergraduate, Department of Metallurgy, University College of Swansea.

TAYLOR, Glyn, Undergraduate, Department of Metallurgy, University College of Swansea.

THOMAS, Clifford Haydn, Undergraduate, Department of Metallurgy, University College of Swansea.

THOMPSON, John, Undergraduate, Department of Metallurgy, University of Manchester.

TURNER, Frank, Undergraduate, Department of Metallurgy, University of Sheffield.

VAUGHAN, Denis, M.Sc., Research Student, Department of Metallurgy, Royal School of Mines, University of London.

VICKERS, David Peter, Undergraduate, Department of Metallurgy, University of Cambridge.

WEBB, Colin Edward, Research Assistant, Fulmer Research Institute, Stoke Poges, Bucks.

PERSONAL NOTES

LORD BAILLIEU has been elected first President of the Institute of Management.

MR. R. G. BAKER has taken up a research appointment at the British Welding Research Association, Abington Hall, Cambridge.

MR. A. S. D. BARRETT, Technical Director of Edwards High Vacuum, Ltd., has resigned from the Board in order to become an independent consultant. He will continue his association with the Company as technical consultant.

MR. K. A. BERBERIAN has left the Raytheon Co. and joined Tang Industries, Waltham, Mass.

MR. F. C. BRABY, Chairman and Managing Director of Frederick Braby and Co., Ltd., has been elected Chairman of the Council of the British Non-Ferrous Metals Research Association in succession to Dr. Maurice Cook.

PROFESSOR MORRIS COHEN, Professor of Physical Metallurgy at the Massachusetts Institute of Technology, has been awarded the Francis J. Clamer Medal of the Franklin Institute.

MR. D. J. H. CORDEROY has graduated from the New South Wales University of Technology and is now employed as a Scientific Officer at the Defence Standards Laboratories (N.S.W. Branch), Sydney.

DR. F. B. CUFF, Jr., is now at the Institut de Recherches de la Sidérurgie, Saint-Germain-en-Laye, (S. et O.), France.

DR. R. A. DODD has left the University of Pennsylvania and is now Associate Professor of Metallurgy at the University of Wisconsin, Madison, Wis.

MR. D. R. EVANS has left Cambridge University and taken up an appointment in the Chemistry Department of Queen's College, Taunton.

MR. J. D. EYRE has left the Defence Standards Laboratories, Melbourne, and taken up an appointment in the Research Department of Wilkinson Sword, Ltd., Colnbrook, Bucks.

DR. M. L. V. GAYLER ceased to act as consultant to the Fulmer Research Institute last September and also resigned her membership of the Dental Industry Standards Committee of the British Standards Institution.

MR. C. A. GRINYER has left Orenda Engines, Ltd., and is now Vice-President in charge of engineering, Atomic Energy of Canada, Ltd.

DR. D. H. KIRKWOOD has left Massachusetts Institute of Technology, where he was working under Professor Chipman with a Post-Doctorate Fellowship, and is now at the Fundamental Research Laboratories of the United States Steel Corp., Pittsburgh, Pa.

Mr. S. W. K. Morgan has been appointed a director of Imperial Smelting Corporation, Ltd.

Mr. S. K. Neogi has left the Department of Mines and Technical Surveys, Ottawa, and is now with the Hindustan Metal Works, Hathras, U.P., India.

Mr. S. O'Hara has left the Royal School of Mines and is now at the Westinghouse Research Laboratories, Pittsburgh.

Mr. C. P. Paton has resigned from the Board of Northern Aluminium Co., Ltd., to take up an important position with Aluminium Ltd., Montreal.

Mr. D. M. Rae, has left H.M. Dockyard, Malta, G.C., and is now at the Admiralty Materials Laboratory, Holton Heath, Poole, Dorset.

Professor A. J. Shaler, Head of the Department of Metallurgy at Pennsylvania State University, is on a year's sabbatical leave in Belgium, his headquarters being with European Research Associates, 95 rue Gatti de Gamond, Uccle, Brussels.

Mr. E. A. Shipley has left Morris Motors, Ltd., to join British Ropes, Ltd., Doncaster, as Head of Research, Wire Division.

Dr. Gareth Thomas is leaving the Metallurgy Department, University of Cambridge, in January to take up a post at the Department of Mineral Technology, University of California, Berkeley, Calif.

Mr. M. D. Tidman has left the City Plating Co., Ltd., Coventry, and is now in the Inspection Department, Dunlop Rim and Wheel Co., Ltd., Coventry.

Mr. W. R. A. Turner has left the Wolverhampton and Staffordshire College of Technology to join the English Electric Co., Ltd., Whetstone, Leicester.

Mr. W. W. Wellborn has left Firth Sterling Inc., Pittsburgh, Pa., and is now Vice-President, Abrasive Dressing Tool Co., Detroit, Mich.

Mr. Charles McE. White, Chairman of the Board and Chief Executive Officer of the Republic Steel Corp., Cleveland, Ohio, is to receive the Benjamin F. Fairless Award of the American Institute of Mining, Metallurgical, and Petroleum Engineers. The Award is made in recognition of distinguished achievements in iron and steel production and ferrous metallurgy.

Mr. A. S. Yamamoto has left the Armour Research Foundation, Chicago, and is now in the Metallurgy Division, Denver Research Institute, University of Denver.

Deaths

The Editor regrets to announce the deaths of:

Mr. Charles Paul Bernhoeft on 29 September 1959.

Mr. David Julius Oscar Brandt, Editor of *Metal Treatment*, on 23 November 1959, aged 39.

Mr. Cyril Ernest Prosser, a former Chairman of the Metals Division of Imperial Chemical Industries, Ltd., at the age of 66.

Mr. Leonard Isaac Shaw, Chairman and Managing Director of B. Mason and Sons, Ltd.

POWDER METALLURGY JOINT GROUP

Symposium on "The Powder Metallurgy of Magnetic Materials"

The Powder Metallurgy Joint Group held a Symposium on "The Powder Metallurgy of Magnetic Materials" at Church House, Westminster, on 16 December. In the evening there was a Conversazione at 17 Belgrave Square, London, S.W.1. Synopses of the nine papers presented at this Symposium are given below. The complete papers are published in *Powder Metallurgy*, No. 4.

The Coercive Force of Fine Iron Powders

By E. H. Carman

(*Imperial College of Science and Technology, London*)

The intrinsic coercive force of compacts prepared from hydrogen-reduced ferric oxide powder has been studied as a function of particle size in the range 200–800 Å. For well-dispersed powder the coercive force increases sharply with particle size to a value of 970 oersteds, where the nominal particle size is 260 Å; above this value the coercive force decreases sharply. An electron-microscope study of powders in the neighbourhood of the maximum shows that the experimentally determined coercive force is in good agreement with recent theory. X-ray line-broadening experiments indicate that packing effects, rather than strain anisotropy within particles, control the coercive force of compacts. A linear variation with packing density is obtained for all particle sizes investigated.

The Development of 50 : 50 Nickel–Iron for Magnetic-Amplifier Cores

By G. P. J. Buchi, T. B. Burnett, and J. E. Thompson

(*Research Laboratories of the English Electric Co., Ltd., Stafford*)

A 50 wt.-% nickel–iron strip 0·004 in. thick has been produced from commercially pure material by powder-metallurgy techniques. The degree of cold rolling and the annealing temperature were varied over a limited range. The suitability of the material for magnetic-amplifier application has been tested by a method described.

Annealing twins, formed during the annealing process, have a deleterious effect on the D.C. coercive force, the A.C. loss, and the magnetic-amplifier characteristics. The density of these twins can be made zero by suitable heat-treatment; for a given degree of cold rolling there is an appropriate annealing temperature to give this result. Experimental results are quoted to show that optimum magnetic properties are achieved in twin-free strip.

The Production of Silicon-Iron Magnetic Strip with the (110) [001] Texture, by Cold Rolling from Sintered Compacts

By E. V. Walker and (Miss) J. Howard

(*Post Office Research Station, London*)

It is shown that secondary recrystallization and development of the (110) [001] texture in 3¼% silicon-iron strip can be obtained by control of the oxygen content of the hydrogen sintering atmosphere. The conditions required are described.

The sintered compact is then cold rolled according to a schedule used for rolling grain-oriented silicon-iron from a cast ingot.

It is found that the temperature of secondary recrystallization is higher than that for conventionally made strip.

It is suggested that a critical amount of silicon is oxidized to silica during sintering and that this silica acts as a dispersed phase in the inhibition-dependent mechanism known to be responsible for secondary recrystallization.

In an appendix by D. C. Shotton an account is given of a short X-ray method for checking the texture of the silicon-iron strip.

The Production of Grain-Oriented 50 : 50 Nickel–Iron Magnetic Strip by Cold Rolling from Sintered Compacts

By E. V. Walker and R. E. S. Walters
(*Post Office Research Station, London*)

50 : 50 nickel–iron strip was cold rolled from sintered compacts to thicknesses of 0·0015 and 0·004 in., with final reductions of 92–99%. After annealing at 1050–1200° C, the cube texture developed, thus giving a material with a rectangular hysteresis loop when magnetized in either the rolling or the transverse direction.

The alloys with the best magnetic properties contained 48–50% nickel. In this range of composition the remanence ratio and coercivity varied from 0·91 to 0·94 and 0·11 to 0·19. respectively, depending upon the processing schedule used.

With the recommended processing schedule, values for the remanence ratio and coercivity of 0·92–0·94 and 0·11–0·13, respectively, were obtained.

Unlike the texture of strip rolled from a conventionally cast ingot, the development of cube texture in strip rolled from a sintered compact is not critically dependent on the temperature of the final anneal.

The Fabrication of Soft Magnetic Alloy Strip from Powders

By H. H. Scholefield and S. G. G. Richardson
(*Telegraph Construction and Maintenance Co., Ltd., Crawley*)

An investigation has been carried out into the properties of high-permeability nickel–iron-base alloys made by powder-metallurgical methods. It is shown that at the upper limits of composition considered the initial permeability of Mumetal is still increasing. With the straight nickel–iron alloys maximum permeability decreases over the range 45–55% nickel, but the initial permeability tends to increase gradually over the upper end of this range. It is shown that the results are reproducible. Mention is also made of sintered silicon-irons and cobalt-irons.

Permanent Magnets from Elongated Single-Domain Particles

By F. E. Luborsky, T. O. Paine, and L. I. Mendelsohn
(*General Electric Company, U.S.A.*)

A process is described for producing elongated single-domain (ESD) fine-particle magnets. The 150-Å ESD iron or iron–cobalt alloy particles are prepared by controlled electrodeposition into mercury, followed by thermal growth and treatment with a third metal to attain optimum particle shape and magnetic properties. The particles are then aligned by a magnetic field, compacted under pressure, freed of mercury by vacuum distillation, and embedded in a suitable matrix. This is ground to a coarse powder and fed into automatic presses for realigning and compacting to the final magnet shape. The factors controlling each step of the process are discussed, and the advantages of magnets with artificial microstructures synthesized by this approach are pointed out. The process described produces commercial ESD iron and iron–cobalt magnets with energy products of 2·2 and 3·5 million gauss-oersteds, and laboratory ESD iron and iron–cobalt magnets of 4·2 and 5·0 million gauss-oersteds.

The Variation in Intrinsic Coercivity of Iron–Cobalt Powders Prepared by Electrolysis into Mercury

By W. Wright
(*Permanent Magnet Association, Sheffield*)

Iron, cobalt, and iron–cobalt alloy particles in mercury have been prepared by electrolysis over a mercury cathode. The intrinsic coercivity at −70° C of these particles has been measured, as deposited and after various heat-treatments; a marked difference in properties is found, which is dependent not only on heat-treatment, but also on whether or not the cathode was stirred during electrolysis. The effect of further metal additions to the iron–cobalt–mercury system is noted. In the discussion an attempt is made to explain the differences observed.

The Effect of Grain Size on Saturation Magnetization of Barium Ferrite Powders

By K. Torkar and O. Fredriksen
(*Technische Hochschule, Graz, Austria*)

Studies on barium ferrite powder showed a decrease in saturation magnetization with decreasing grain size. This phenomenon had previously been observed in iron and magnetite powders and was attributed to the existence of a disturbed layer on the individual powder grains (Hüttig's surface layer). This layer may vary in thickness according to the manufacturing process used, and the degree of disturbance will increase with the fineness of the powders.

A Study of the Magnetic Properties of Sintered Ferrites, Using Single-Crystal Data

By F. W. Harrison, K. Hoselitz, and J. E. Knowles
(*Mullard Research Laboratories, Salfords, nr. Redhill*)

An indication of the dependence of the magnetic properties of polycrystalline sintered ferrites on the conditions of preparation is given.

In the design and understanding of the properties of these materials it is valuable, and sometimes essential, to make use of data obtained from measurements on single crystals. Methods of preparation of ferrite single crystals, namely the Verneuil or flame-fusion method, the Bridgman–Stockbarger method, and the lead oxide flux method, are briefly described.

To illustrate the way in which measurements on polycrystalline and single-crystal specimens complement each other in the understanding of the magnetic behaviour of ferrites, an investigation of the properties of a ferrite with a so-called " square " hysteresis loop is discussed.

" Powder Metallurgy " No. 4

In addition to the nine Symposium papers given above, *Powder Metallurgy* No. 4 contains two further papers and two reports of discussions:

The Powder Metallurgy of Titanium–Tin Alloys Containing up to 15% Tin

By R. F. Smart and Professor E. C. Ellwood

(*Tin Research Institute, Greenford*)

Density measurements and data on the mechanical properties of titanium–tin alloys, fabricated by powder metallurgy from sodium-reduced titanium, are reported.

Low porosities were achieved after a single pressing and sintering operation. A typical set of preparation conditions involved compacting at 40 tons/in.^{2} and sintering, in vacuum, at 1300° C for 1 h. With tin contents above 5%, evaporation of tin during sintering could prove troublesome.

The presence of tin strengthened titanium markedly. The addition of 15% tin increased the ultimate tensile stress at room temperature by ~90%, with a corresponding, though less marked, reduction in ductility.

Observations on the Sintering of S.A.P.

By E. M. Modl-Onitsch

(*Research Laboratories of Aluminium Industrie A.G., Neuhausen, Switzerland*)

Discussion on " Theoretical Aspects of Sintering "

A summary of the discussion held on 29 April 1959.

Discussion on " The Powder Metallurgy of Metal–Ceramic Materials "

A summary of the discussion held on 17 December 1958.

Powder Metallurgy, which appears twice a year, is the official organ of the Powder Metallurgy Joint Group. It is obtainable by annual subscription at 25*s*. (post free) to non-members; members of The Iron and Steel Institute and The Institute of Metals may obtain it for an annual fee of 10*s*. post free.

JOINT ACTIVITIES

Joint British Committee for Vacuum Science and Technology

After The Institute of Physics's London Conference on high vacua held in April last, various suggestions were made for arranging regular British meetings on vacuum science and technology, and for British participation in international conferences in this field.

As a result of informal discussions between societies and institutes in this country a "Joint British Committee for Vacuum Science and Technology" has now been formed. The Committee consists of representatives from each of the following bodies: Institute of Biology, Institution of Chemical Engineers, Royal Institute of Chemistry, Institution of Electrical Engineers, Iron and Steel Institute, Institution of Mechanical Engineers, Institute of Metals, Institute of Petroleum, Physical Society, and Institute of Physics.

Its objects are:

(*a*) To co-ordinate and help to initiate meetings in the whole field of vacuum science and technology arranged by constituent bodies and

(*b*) to act in the collective interest of the constituent bodies by maintaining liaison with the International Organization for Vacuum Science and Technology and with national vacuum societies, and otherwise.

The Institute of Physics has agreed to provide the secretariat for the joint committee; communications should be addressed to the Secretary of the Joint British Committee for Vacuum Science and Technology at its headquarters, 47 Belgrave Square, S.W.1.

LECTURES TO LOCAL SECTIONS AND ASSOCIATED SOCIETIES*

Economics of Rolling Mill Layouts

At a meeting of the South Wales Local Section held in Swansea on 11 November, Mr. W. F. CARTWRIGHT, Assistant Managing Director of The Steel Company of Wales, Ltd., gave a lecture based upon a paper entitled "Flat Rolling: the Effect of Plant Design and Layout on Capital and Operating Costs", presented by Mr. M. F. Dowding and himself at the Latin American Meeting of Experts on the Steelmaking and Transforming Industries in São Paulo in October 1956.

The thesis of the paper, which applies equally well to any underdeveloped country, is that a Steckel hot mill with reversing cold mills is the cheapest installation for making modern cold-rolled products, although the output is limited to about 350,000 tons per annum, and the quality is restricted to low-grade sheet, galvanizing stock, and tinplate. The capital cost is around £23,000,000, and the products cost approximately £60 per ton for cold-reduced sheet and £69 per ton for blackplate.

A semi-continuous hot mill with a reversing or tandem cold mill is capable of turning out the full range of products of a continuous mill, though with reduced yields, and provides a better combination of wide plate and wide strip products than does a continuous mill for outputs of up to 1,000,000 tons per annum. Approximate capital and product costs are estimated as follows:

Annual Output, tons	Capital Cost	Cold-Rolled Sheet, cost per ton	Blackplate for Tinplate, cost per ton
500,000	£31,500,000	£57	£65
800,000	£36,000,000	£51	£59

If demand is high enough, separate plate and strip mills should be installed to enable higher yields of both products to be obtained. If outputs exceeding 1,000,000 tons per annum are required, a continuous hot strip mill with tandem cold mills should be installed at a capital cost of about £75,000,000, giving a cost per ton for cold-reduced sheet of about £48, and a blackplate cost of about £52 per ton.

Capital production costs are based on hypothetical conditions. Starting with slab costs of £35 per ton, seven tables of yields and usings have been utilized in the calculations to show comparative costs, but it is emphasized that the yields and usings quoted must be modified to suit local conditions when attempting to forecast likely production costs for various projects.

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* Please note that full texts of these lectures are *not* available from the Institute.

The authors emphasized in their paper that, in their opinion, the Steckel would always be an inferior solution to the problem of a low-capital-cost strip-rolling plant, and that they would prefer in every case to use a semi-continuous mill with four finishing stands as a starting point, rather than a hot Steckel mill. The authors did not have the same objection to the use of reversing cold mills, which, with modern automatic gauge control, could produce a very satisfactory product comparable with that of the tandem mill.

Aluminium Casting Alloys and Foundry Practice

Members of the Leeds Metallurgical Society, on 12 November, heard a lecture on aluminium casting alloys by their President, Mr. W. L. Bolton, of West Yorkshire Foundries, Ltd., Leeds, in which he dealt with the properties of the alloys, the reasons for their development, and their selection, handling, and treatment. The B.S. 1490 series of alloys was considered and also D.T.D. 5008 and the 22% silicon alloys.

The development of the alloys was dealt with in chronological order of commercial usage, and binary and quasi-binary equilibrium diagrams were illustrated with lantern slides, as also were typical microstructures.

The importance of the liquidus/solidus interval and the volume of eutectic was illustrated in relation to foundry properties; the wide-freezing-range, small-eutectic-volume alloys are prone to suffer from dispersed interdendritic porosity and hot tearing, thus leading to foundry difficulties, and such alloys are very difficult to cast into permanent metal moulds.

The narrow-freezing-range alloys of eutectic composition were shown to be suitable for pressure castings because of their marked directional-solidification characteristics, but difficult to handle in heavy-section castings owing to pronounced localized shrinkage. An example was given in which the feeding characteristics of LM9WP enabled a sound casting, with mechanical properties similar to those of LM16WP, to be produced, whereas soundness could not be obtained in the latter alloy, since design and machining coniderations precluded feeding in isolated heavy sections.

The alloys with intermediate freezing range and medium eutectic volume, e.g. LM4, LM12, LM21, and LM22, were examined and shown to be versatile with regard to cost, mechanical properties, and machinability.

The combination of the copper and silicon alloys to improve foundry properties and the development of the high-strength heat-treatable alloys, namely LM8, LM9, LM10, LM11, and LM16, and the high-temperature alloys LM12, LM13, LM14, and LM15, were discussed from the metallographic point of view.

The influence of sodium and sodium salts on the eutectic aluminium–silicon alloys was illustrated, and foundry techniques for metal treatment were outlined. The treatment of the 22% silicon alloy with phosphorus to refine the hypereutectic silicon was illustrated, and an example was given where the addition of copper and nickel made the alloy responsive to heat-treatment and improved its strength at high temperatures.

Foundry practice was described with particular reference to types of melting units, fluxes, and the choice of degassing methods.

Gas detection on solidification of metal samples in semi-permanent refractory moulds was described and shown to be capable of detecting gas contents in LM4-type alloys which were as low as 0·25 c.c./100 g. This gas figure was considered to be low enough for the production of the majority of commercial castings. This figure had been determined in relationship to readings taken on a Ransley gas-measuring apparatus, which, though useful as a research tool, was considered too fragile for routine commercial use.

Foundry techniques were illustrated with particular reference to sand moulds, gravity dies, and pressure dies.

Properties, Applications, and Metallurgical Aspects of Nimonic Alloys

Dr. W. Betteridge, of The Mond Nickel Co., Ltd., gave a lecture on the Nimonic alloys to the Southampton Metallurgical Society on 29 October.

The oxidation-resistant characteristics of the binary nickel–chromium alloy containing 20% chromium have been known for over 50 years, and this alloy formed the starting point from which the present series of high-strength high-temperature alloys was developed. The first alloy, Nimonic 75, contains about 0·3% titanium, which is within the solid-solution range, but the alloy shows some capability of being hardened by the precipitation of chromium carbide. The remaining alloys all have higher contents of titanium associated with a balanced addition of aluminium, and they are all hardened by the precipitation of the phase $Ni_3(TiAl)$, which is isomorphous with, and nearly equiparametric with, the matrix. The steadily increasing high-temperature strength in successive alloys developed is the result of increasing complexity of the matrix, additions of cobalt, molybdenum, &c. being made in the more advanced alloys; of the optimum selection of the levels of aluminium and titanium; and of the careful control of the contents of trace constituents, some of which are beneficial and some deleterious. The permissible operating temperature for a given life at a fixed stress has thereby been increased by about 150° C. from Nimonic 80 to Nimonic 105, and it is expected that further increases will be achieved in alloys at present in the development stage.

The optimum heat-treatment to develop well-balanced creep and rupture properties is not a simple matter of solution- and precipitation-treatments. This is illustrated particularly by the temperature adopted for the solution-treatment stage, which is well above that indicated as satisfactory on purely constitutional grounds, and is selected to give the highest possible degree of annealing consistent with avoidance of grain growth. In some cases two stages of precipitation are included to ensure the optimum distribution of precipitated carbides, which has a marked influence on creep elongation at fracture, and to obtain satisfactory hardening by the precipitation of $Ni_3(TiAl)$.

The high-temperature mechanical properties of the alloys need to be considered very carefully in the design of critically-stressed components. At temperatures below about 500° C, the normal short-time tensile properties form a suitable basis for design, but at higher temperatures the creep properties must be considered in the light of the permissible strain and anticipated life. The effect of notches on high-temperature rupture properties is of some significance, since, in certain conditions of heat-treatment, there exist ranges of temperature in which the alloys are, to a small extent, notch-sensitive. On the other hand the high-temperature fatigue strength, at least under the simpler conditions of uniaxial or rotating-bending stressing, are closely related to the rupture strength.

The progressively increasing mechanical strength of the alloys has permitted them to be used at increasing temperatures, and this has resulted in renewed consideration being given to the corrosion characteristics in order to ensure adequate resistance to the various attacking media, whether gaseous, molten, or solid, likely to be encountered in service.

Metal Spraying

On 20 October Mr. W. E. BALLARD, of Metallisation Ltd., gave a lecture to the North East Metallurgical Society, which was devoted mainly to a consideration of the uses of metal spraying for the reclamation of worn parts.

For this purpose it is necessary to prepare the surfaces to be treated so as to obtain maximum adhesion. Several methods are available, but some doubt has been expressed about their effect upon fatigue strength and the limit of endurance. Practical experience has indicated that there is small danger in this respect, but very little scientific work has been carried out until recently. Reference must be made to the work of Lee Williams in America, Birchon of the Admiralty, and several investigators on the Continent. It is clear that methods of roughening by electric arcs are most dangerous and that grit-blasting is preferable to rough cutting, although the bond is less good. The use of molybdenum can also cause some decrease in endurance limit, but this may largely be rectified by using a combination of molybdenum treatment and shot-blasting. The adherence of molybdenum is not yet fully understood, but there is some evidence of incipient alloying which is not found with other sprayed metals.

Sprayed deposits have a characteristic structure no matter which system of application is used. In Britain the gas wire pistol is mostly employed for reclamation, but on the Continent arc pistols are used to some extent. The deposit, being porous, has the ability to produce surfaces which, after machining or grinding, retain oil films and maintain lubrication. High-carbon and alloy steels are generally used for reclamation work, although non-ferrous metals are often applied. In Poland, bearings of metallic mixtures such as aluminium and lead are made by spraying. The spray-weld process, a combination of spraying and fusion techniques, gives a convenient method of hard facing by means of boron-rich alloys of nickel or cobalt, usually in powder form. Still harder surfaces can be produced by the addition of tungsten carbide to the alloy powders. Recently, the metal-spraying process has been adapted to spray ceramic materials such as alumina, zirconia, and zircon. Such coatings are excellent heat insulators and are used for protecting strain-gauges at high temperatures. Metal spraying is also used for building up solid bodies, as in the manufacture of wave guides and formers for the spark erosion method of machining.

Some Recent Advances in Soviet Metallurgy

In a lecture given to the Leeds Metallurgical Society on 8 October, Dr. P. FELTHAM, of Leeds University, described a visit he had recently made to the U.S.S.R.

Dr. Feltham said that one of the first impressions he had on arriving in the Soviet Union in August was of several colourful posters, just outside the dock gates of Leningrad, each showing some industrial plant and an upwards sloping arrow pointing to a production target for 1965—the end of the current seven-year plan. By that date the U.S.S.R. was to be producing well over 90 million tons of steel annually, and was to have three times as many qualified specialists as the U.S.A. possesses now.

In the metallurgical field, six major periodicals are published in the Soviet Union, all containing original work; in addition, articles on metallurgy or metal physics appear, together with papers on other topics, in a number of journals published by the Academy of Sciences and various regional research and teaching institutes.

To achieve the ambitious targets of the seven-year plan, large projects are under construction. Blast furnaces exceeding in capacity the biggest now being built in the U.S.A. by about 50%, are being erected, and vast plants for the production of ferro-alloys, aluminium, &c. are nearing completion. Many of these are located in the central and eastern regions of the country. The Asian part of the Soviet Union is to produce one-third to one-half of the total industrial output within the next few years. The necessary power plant is also in the process of construction; a not inconsiderable fraction of the new power is to come from the Siberian rivers.

Soviet scientists and technologists are always concerned about productivity, and the most modern techniques, particularly automation, are very carefully studied and keenly applied. "Automation" is a kind of magic word, and even laymen will discuss it with lively interest.

The planned full automation of the most important metallurgical production processes requires skilled personnel and sensitive, yet robust, equipment. Special automation institutes are concerned with providing the latter. For example, an optical pyrometer, developed by the Moscow Institute of Automation and Remote Control, can record temperatures up to 2000° C within less than 1 sec. It works on the "null method" and is therefore highly accurate. Fast-response instruments for checking tolerances of rolled and extruded shapes during production are also coming into wide use.

Metallurgical research institutes exist in many regions of the country; in Moscow alone, metals are being studied at four different centres. In one department of the Institute of Machine Science, in the centre of Moscow, for example, five men and five women (some working for higher degrees) carry out research on the high-temperature properties of metals and alloys under the direction of Dr. M. G. Lozinskii. The laboratories are very well equipped; several high-temperature microscopes for use in conjunction with indenters or creep machines are used in studies of steel and also of rare metals. The machines are generally designed to give the largest possible amount of information at one and the same time. Thus, specimens subjected to high-temperature creep *in vacuo* could be examined by X-rays and filmed or visually observed during deformation. Special fine-focus X-ray tubes, with a 5μ focal spot, are available commercially in the U.S.S.R. With these, a back-reflection photograph may be obtained within 3 min.

The concern about efficiency and productivity appears to be an integral part of the thinking of the scientist there in relation to the design of experiments; this also applies to "pure" research, which, after all, is likely to be of practical importance to-morrow. Certain aspects of metal physics, e.g. the theory of dislocations, have so far received less attention than in Britain. In fact there seem to be several fields in which developments in the U.S.S.R. and Britain are largely complementary.

OTHER NEWS

Anglo-French Meeting on Non-Destructive Testing

The Non-Destructive Testing Group of the Institute of Physics will hold a meeting in London on 2–4 May, 1960, jointly with the Société Française de Métallurgie. The programme will have the general theme of the relationship between structure and physical properties of materials and will include recent advances in non-destructive testing techniques. Further details may be obtained from The Secretary, The Institute of Physics, 47 Belgrave Square, London, S.W.1.

The Physical Society Exhibition of Scientific Instruments and Apparatus

The annual Exhibition of Scientific Instruments and Apparatus arranged by the Physical Society will be held in London from Monday 18 to Friday 22 January. Members of The Institute of Metals who would like to receive complimentary tickets admitting to the Exhibition on Tuesday to Friday, inclusive, should apply to The Secretary of The Institute of Metals. These tickets are available as follows:

Tuesday, 19 January . .	10 a.m. to 9 p.m.
Wednesday, 20 January . .	10 a.m. to 7 p.m.
Thursday, 21 January . .	10 a.m. to 7 p.m.
Friday, 22 January . . .	10 a.m. to 1 p.m.

As in past years, the Exhibition will remain open during the lunch-hour.

In connection with the Exhibition, which will be held at The Royal Horticultural Society's Old and New Halls, Westminster, London, S.W.1, there will be a Discourse on Wednesday, 20 January, at 5.45 p.m. on "Recent Advances in Solid-State Physics" by Dr. D. A. Wright (Research Laboratories of The General Electric Co., Ltd.). Special admission tickets for this Discourse are not required.

Argentine Metallurgical Meeting

The First Argentine Metallurgical Meeting was held in Buenos Aires on 15–22 November 1959. It was organized by the Sociedad Argentina de Metales in association with the Universities, research laboratories, and commercial firms. Technical sessions were held at which scientific papers, including some from abroad, were discussed, and there were visits to works in Buenos Aires, Cordoba, and San Nicolas.

Deutsche Gesellschaft für Metallkunde

The next annual meeting of the Deutsche Gesellschaft für Metallkunde will be held in Vienna from 9 to 11 June 1960.

Special Courses at Kingston Technical College

Two courses of special lectures have been arranged by the Metallurgy Section of Kingston Technical College early in 1960. The first course, on Tuesday evenings beginning on 16 February, deals with "Corrosion Problems in the Aircraft Industry" and the second, on Thursday evenings beginning on 18 February, deals with "The Technology of Copper-Base Alloys". The lectures, of which there are six in each course, will be given by specialists from industry. The fee for each course is 12*s.* 6*d.* and advance registration is advisable. The address of the College is Fassett Road, Kingston-upon-Thames.

Industrial Archæology

The Council for British Archæology has recently formed a Research Committee on the subject of the Archæology of the Industrial Revolution. It includes archæologists, economic historians, geologists, architects, technologists, and others interested in surviving industrial remains of the seventeenth to nineteenth centuries. It is hoped that the Committee will be able to draw into a programme of planned recording and research the wide variety of interests in the subject.

The Committee's first project was a public conference on 12 December, 1959, at which papers on recent pieces of research, on the problems awaiting study and the methods required, were presented.

The Council's address is 10 Bolton Gardens, London, S.W.5.

DIARY

2 February. Oxford Local Section. "Some Metallurgical Factors in the Failure of Engineering Structures", by Dr. L. E. Benson. (Cadena Café, Cornmarket Street, Oxford, at 7.0 p.m.)

2 February. South Wales Local Section. "The Use of Welded Metal", by D. L. Slater. (Metallurgy Department, University College, Singleton Park, Swansea, at 6.30 p.m.)

4 February. Birmingham Local Section. Students' Evening. (College of Technology, Gosta Green, Birmingham 4, at 6.30 p.m.)

4 February. London Local Section. "Thermal Shock", by R. J. E. Glenny. (17 Belgrave Square, London, S.W.1, at 6.30 p.m.)

10 February. Manchester Metallurgical Society. "The Precipitation-Hardening Stainless Steels", by J. I. Morley. (Manchester Room of The Central Library, Manchester, at 6.30 p.m.)

11 February. East Midlands Metallurgical Society. Members' Night. (School of Art, Green Lane, Derby, at 7.30 p.m.)

11 February. Leeds Metallurgical Society. "Flames and Furnaces", by Professor M. W. Thring.

11 February. Liverpool Metallurgical Society. "Recent Researches in the Corrosion and Protection of Iron and Steel", by Dr. J. C. Hudson. (Joint meeting with the Society of Chemical Industry (Liverpool Section)). (College of Technology, Liverpool, at 7.30 p.m.)

18 February. Birmingham Local Section. "Metals and High-Speed Flight", by Professor A. J. Kennedy. (College of Technology, Gosta Green, Birmingham 4, at 6.30 p.m.)

18 February. Sheffield Local Section. "Research Topics". Three short accounts of work in progress in local research laboratories. (Applied Science Building of the University, St. George's Square, Sheffield 1, at 7.30 p.m.)

22 February. Scottish Local Section. "The Manufacture of Ships' Propellers", by A. L. Wakeling. (Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C.2, at 6.30 p.m.)

24 February. Manchester Metallurgical Society. "The Presentation of Metallurgical Information", by Dr. J. W. Jenkin. (Manchester Room of The Central Library, Manchester, at 6.30 p.m.)

25 February. North East Metallurgical Society. "Copper and Copper Alloys in Modern Technology", by Dr. E. Voce. (Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough, at 7.30 p.m.)

25 February. Southampton Metallurgical Society. "Strain-Ageing of Steel", by T. R. S. Williams. (Engineering Block, Southampton University, at 7.15 p.m.)

APPOINTMENTS VACANT

A.E.R.E., HARWELL

Head of Reactor Metallurgy Branch

Applications are invited for this SENIOR APPOINTMENT in the METALLURGY DIVISION at A.E.R.E., HARWELL. The Branch comprises Groups working on a wide range of metallurgical topics, including beryllium, plutonium, ceramics, fabrication, oxidation, and corrosion. The Head of the Branch will be responsible for the general conduct of this work and for relating it to the needs of the reactor programme; in this latter task he will be assisted by a Group whose function is to define the metallurgical problems of the various reactor systems and to maintain liaison with designers and other experimental establishments.

Applicants should have a good honours degree and preferably be metallurgists by training and experience. They must have had considerable experience in directing scientific research. A good knowledge of reactor systems and the associated metallurgical problems is desirable.

Salary—Between £3000 and £3500 p.a.

Superannuation and Housing Schemes.

Please send a POST CARD for details to Group Recruitment Officer, (1500/228), U.K.A.E.A., A.E.R.E., Harwell, Didcot, Berks.

A.E.R.E., HARWELL

X-Ray Microprobe Analyst

Ref. 1495/233. Metallurgists, Physicists, and Chemists are invited to apply for a post concerned with the exploitation of this powerful new technique, with special reference to basic problems in nuclear metallurgy and solid-state physics and chemistry.

The appointment will be made in either the scientific officer or experimental officer class, depending on experience and qualifications. Some acquaintance with electrons or X-ray diffraction techniques would be an advantage.

Metallurgists

Ref. 1494/233. The following posts are available in the Metallurgy Division at Harwell in sections studying the physical metallurgy of uranium, magnesium, and zirconium alloys as part of the fundamental research programme related to nuclear reactor developments.

Principal and Senior Scientific Officers (£1260–£2155 p.a.)

Experienced Metallurgists to lead or work within Sections should possess good honours degree and have relevant research experience. Familiarity with techniques of crystallographic and alloy studies is desirable.

Scientific Officers (£675–£1160 p.a.)

Should have a good honours degree in Metallurgy or Physics. Previous research experience is not essential, but applicants with 3 years' approved postgraduate experience will receive a salary of not less than £850.

Experimental Class (£1025–£1685 p.a.)

Experimentalists should have H.N.C. or equivalent and a substantial interest in new developments. Applicants with experience in metallography of similar metals, in X-ray diffraction techniques, or in physical property measurements will be considered for Senior Experimental Officer and Experimental Officer posts. Applicants under 26 will be considered for Assistant Experimental Officer posts (£500 at 20—£725 at 26).

Housing and Superannuation Schemes.

Please send a POST CARD, quoting appropriate Ref. No., for details to:—

Group Recruitment Officer, U.K.A.E.A., A.E.R.E., Harwell, Didcot, Berks.

A METALLURGIST

is required at

A.E.R.E., HARWELL

to study the effect of irradiation upon the properties of metals and ceramics. Applicants should have a 1st or good 2nd class honours degree in Physics or Metallurgy. They will have ample scope for scientific initiative in a new and expanding subject. Experience in solid-state research would be an advantage.

Salary: £675–£2155 p.a., according to qualifications and experience.

Housing and Superannuation Schemes.

Please send a POST CARD for details to Group Recruitment Officer, (1532/228), U.K.A.E.A., A.E.R.E., Harwell, Didcot, Berks.

A YOUNG PHYSICIST is required to carry on research on phenomena associated with electric arcs. The work will have a bias towards the development of novel processes for commercial exploitation. Although the possession of an honours degree or equivalent qualification is essential, imagination and interest are more important than previous experience in this field. Please write to Box No. 450, The Institute of Metals, 17 Belgrave Square, London, S.W.1.

AUSTRALIA

THE UNIVERSITY OF NEW SOUTH WALES

SENIOR LECTURER/LECTURER IN

CHEMICAL AND EXTRACTION METALLURGY

The University of New South Wales invites applications for appointment to the position of Senior Lecturer/Lecturer in Chemical and Extraction Metallurgy in the School of Metallurgy.

Salary: Senior Lecturer, £A2224 range £A2574 per annum.
Lecturer, £A1524 range £A2124 per annum.

Commencing salary according to qualifications and experience.

Applicants for position of lecturer must possess a degree, with honours, or possess equivalent qualifications; for appointment as senior lecturer, applicants must possess a higher degree or equivalent qualifications.

Applicants should have had research and/or industrial experience and interest in the physico-chemical aspects of metallurgical processes is desirable.

Appointee will be eligible for 12 months' study leave on full salary after 6 years of service.

Subject to passing a medical examination, the appointee will be eligible to contribute to the State Superannuation Fund.

First-class ship fares to Sydney of appointee and family will be paid.

Four copies of applications should be lodged with the Agent General for New South Wales, 56–57 Strand, London, W.C.2, and a copy forwarded by airmail in an envelope marked "University Appointment" to the Bursar, The University of New South Wales, Box 1, Post Office, Kensington, New South Wales, Australia, by *31 January, 1960.*

BABCOCK & WILCOX, LIMITED

An Assistant Metallurgist is required for their Atomic Energy Department located in London. His function will be to work with the engineers in the department on the selection and application of both metallic and non-metallic materials. He will be particularly concerned with those used in the cores of water- and gas-cooled reactors. Applicants should preferably have a degree and some experience in the field of materials selection.

Applications to be made in writing to:

The Assistant Secretary,
BABCOCK & WILCOX, LTD.,
209, Euston Road,
London, N.W.1.

METALLURGIST (Scientific Officer) required by MINISTRY OF AVIATION at National Gas Turbine Establishment, Pyestock, Farnborough, Hants., for basic studies of behaviour of wide range of materials for high-temperature service; primarily on effects on fracture of thermal stresses, structural factors, and environmental conditions. 1st or 2nd Class honours degree in metallurgy or equiv. qual. required. Salary range £615–£1090. F.S.S.U. terms. Opportunities for establishment if under 31. Forms from Ministry of Labour, Technical and Scientific Register (K), 26, King Street, London, S.W.1, quoting reference F.803/9A.

SINTERED CEMENTED CARBIDES (HARD METAL)

Important producer of this material for mining purposes invite applications from

METALLURGISTS

for the position as assistant to the Factory Manager in all phases of management and production. Applicant must have had practical experience in this specialized field, coupled with ability to act on own initiative. The position offers excellent scope, as successful applicant will be given all possible assistance and encouragement in undertaking responsibilities involved. Initial salary offered will be commensurate with age, qualifications, and experience. Non-contributory pension scheme. Replies, which will be treated as confidential, giving details should be sent to the Managing Director of A. Johnson & Co. (London) Ltd., Villiers House, Strand, London, W.C.2.